

Notice of Allowability

Application No.

10/707,025

Examiner

Stephen Rosasco

Applicant(s)

HUANG, TENG-YEN

Art Unit

1756

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to IDS 4/26/04.
2. ☒ The allowed claim(s) is/are 1-19.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date 4/26/04
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____.
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

ALLOWANCE

The following is an examiner's statement of reasons for allowance: the claimed invention is distinguished over the prior art of record in that the prior art does not teach an optical proximity correction (OPC) method for correcting a photomask layout, the photomask layout comprising at least a first photomask pattern including a first straight line having a first line-end arranged in a first direction and a second straight line arranged in parallel with the first straight line, the second straight line having a second line-end being longer and more protrudent than the first line-end, the OPC method comprising: performing a rule-based OPC process to generate a corrected photomask layout; and adding an enhancing feature in the first line-end, a width of the enhancing feature being smaller than a width of the first straight line, and the second line-end being still more protrudent than the first line-end with the enhancing feature.

And wherein the photomask layout further comprises a second photomask pattern, the second line-end being closer to the second photomask pattern than the first line-end, and the second line-end reaches to the first photomask pattern.

The applicant discusses the limitations of the prior art in that in the corrected photomask layout 16 according to the rule-based OPC process, an assist feature 18 that can avoid a right-angled corner rounding situation or a split in the straight line resulting from the OPE is added to the line-end closer to the second photomask pattern 14 of the second straight line 12b so that no serious defects occur at the intersection of the second straight line 12b and the second photomask pattern 14. However, in the corrected photomask layout 16 according to the conventional rule-based OPC, as shown in FIG. 2, the defects of line-end shortened still exist in the first, the third, and the fourth straight lines 12a, 12c,

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and 12d. More seriously, a "bridge problem" occurs at the intersection of the second straight line 12b and the assist feature 18, which means a weak point P.sub.W looking like a bridge or a neck shape appears in the photoresist layer resulting from the light scattering ability or the light reflectivity of materials. This problem often occurs in the second straight line 12b with longer length, and the location of the weak point P.sub.W is horizontal with the line-ends of the first straight line 12a and the third straight line 12c near the second straight line 12b. As shown in FIG. 2, the weak point P.sub.W of the second straight line 12b is very narrow. This will probably cause a defect such as a broken circuit in following production processes. In a more serious situation, an opening of the second straight line 12b may be present at the weak point P.sub.W, resulting in that the whole product has to be abandoned.

And the applicant states that although the prior-art model-based OPC process can generate a better correction result, it takes a huge amount of time to perform modeling calculations and tests, which cannot match the requirements of a factory of being highly efficient and low cost.

Zhang (20040219436) teaches a method that performs target-image-based optical proximity correction on masks that are used to generate an integrated circuit, comprising: receiving a plurality of masks that are used to expose features on the integrated circuit; computing a target image for a target feature defined by the plurality of masks, wherein mask features from different masks define the target image; dissecting the mask feature into a plurality of segments, wherein dissecting the mask feature involves using dissection parameters associated with geometric characteristics of the target image, instead of using dissection parameters associated with geometric characteristics of the mask feature; and

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performing an optical proximity correction (OPC) operation on the plurality of masks, wherein the OPC operation uses parameters associated with geometric characteristics of the target image to perform optical proximity correction on mask features that define the target image.

Lin (6,598,218) teaches an optical proximity correction method, comprising the steps of: providing a layout pattern with a minimum feature width, wherein the layout pattern includes a plurality of features and each feature has a plurality of corners; placing a first assist feature over each corner of the features in the layout pattern, wherein one-fourth to one half of a width of the first assist feature overlaps with the corner and one half to three-fourths of the length of the first assist feature overlaps with the corner, such that a resulting profile after a light exposure has a broadened tip portion; and replacing each of two neighboring first assist features by a second assist feature when the neighboring first assist features touch or overlap.

And wherein the first assist feature includes a first corner serif and a width-to-length ratio of the first corner serif is between about 0.5 and 1.0.

Pierrat et al. (6,539,521) teach a method of correcting for proximity effects associated with an edge of a polygon in a layout, the method comprising: receiving a first target length (L_{cor}) for corner segments, a second target length (L_{det}) for non-corner segments, and a plurality of characteristics of the edge including edge length L , line end, and turn end; determining whether the edge is a short edge using the plurality of characteristics, L_{cor} , and L_{det} ; using a first algorithm for providing dissection points and placing an evaluation point on the edge, if the edge is a short edge; using a second algorithm for dissecting the edge into segments, providing dissection points between the

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segments, and placing evaluation points on the segments, if the edge is longer than a short edge; and responsive to the providing and placing, correcting the edge for proximity effects.

And wherein if L is less than a minimum dissection length, then providing no dissection points and no evaluation point.

And wherein determining whether the edge is a short edge includes determining whether L is less than twice a minimum dissection length, the minimum dissection length being one of L_{cor} and L_{det} .

And wherein for a short edge providing dissection points and placing an evaluation point on the edge includes: selecting two vertices associated with the edge as dissection points; and placing the evaluation point at a point between the two dissection points; and further including determining whether the edge is a long edge using the plurality of characteristics, L_{cor} , and L_{det} .

And wherein determining whether the edge is a long edge includes determining whether L is at least a sum of L_{det} and 2.times. L_{cor} .

And wherein, for an edge longer than a short edge but shorter than a long edge, determining whether the edge has an associated convex vertex and an associated concave vertex.

However, the prior art of record does not teach a first line-end arranged in a first direction and a second straight line arranged in parallel with the first straight line, the second straight line having a second line-end being longer and more protrudent than the first line-end, the OPC method comprising: performing a rule-based OPC process to generate a corrected photomask layout; and adding an enhancing feature in the first line-end, a width of the enhancing feature being smaller than a width of the first straight line,

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and the second line-end being still more protrudent than the first line-end with the enhancing feature.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Stephen Rosasco whose telephone number is (571) 272-1389. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. The Examiner's supervisor, Mark Huff, can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'S. Rosasco', with a stylized, elongated 'S' and a trailing flourish.

S. Rosasco
Primary Examiner
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S. Rosasco
09/29/05